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Competition and innovative intentions: A study of Dutch SMEs

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Competition and innovative intentions: A study of Dutch SMEs
Research report

Abstract
This paper explores the complex relationship between competition and innovation. Traditional measures of competition using industry statistics are often challenged and found wanting. This paper distinguishes between three types of competitive forces: internal rivalry among incumbent firms in an industry, bargaining power of suppliers, and bargaining power of buyers. Using survey data from 2,281 Dutch firms, we apply new perception-based measures for these competitive forces to explore how competition relates to firms' innovative intentions. We also investigate the influence of innovation strategy as a contingency variable. Results show that specific innovative intentions, i.e. to invest in product and process innovation, are related to different competitive forces. Process innovation is correlated with the bargaining power of suppliers, while intentions to invest in product innovation are associated with buyer power. Finally, intended product innovation is related to internal rivalry, but only when firms have no innovation strategy.

Keywords
Perceived competition, innovation, innovative intentions, product innovation, process innovation, internal rivalry, supplier power, buyer power, strategy, SMEs.

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1. Introduction

Innovation is an important driver of economic and productivity growth and ultimately of the improvement in living standards. It has become an important topic for policy makers, researchers and practitioners. Many policy makers and researchers believe that competition promotes innovation. This belief has widespread consequences, as it has been a driving force behind numerous important policy changes, ranging from the deregulation of numerous industries in the OECD economies to many of the economic reforms in Eastern Europe (Nickell, 1996). A similar belief is found among practitioners in business. Meeting competition is generally presented as the prime purpose of innovation in texts aimed at managers and entrepreneurs, as reflected in titles such as *Managing Technological Innovation: Competitive Advantage from Change* (Betz, 2003) and *Innovation: the Attacker's Advantage* (Foster, 1986).

Given such examples, the belief that competition and innovation are positively connected seems widespread. This view is in line with the initial work of Schumpeter (1934) on economic development, in which he suggested that innovations are sourced from entrepreneurs via small and/or new entering firms. Knowledge is mainly public knowledge and cannot be appropriated, and incumbent firms have fewer incentives to invest in innovation. In this hypothesis, which has become known as Schumpeter Mark I, innovation is positively linked with competition. It is a consequence of small, entrepreneurial firms challenging the status quo.

It should not, however, be assumed that innovation is always the best response to competition. A cautionary example is the avoidance of competition by making price agreements or the geographical cornering of markets. Strategic management literature has identified various alternatives in the context of deciding how to respond to competitive threats. Innovation is only one of these (Gatignon & Reibstein, 1997). In his later work, Schumpeter (1942) put forward an alternative hypothesis that even implies a negative connection between competition and innovation. Schumpeter's idea was that large firms can appropriate the main part of their innovations. This provides them with the incentives and opportunities to innovate again. Thus, in this hypothesis firms undertake innovation because they seek profitable opportunities that arise from a monopoly position, i.e. a lack of competition. This Schumpeter Mark II hypothesis has been followed and tested by many industrial organization authors (e.g. Grossman & Helpman, 1991; Romer, 1990).

Empirical evidence as to the relationship between innovation and competition is ambiguous. After surveying the literature on testing the Schumpeter Mark II hypothesis, Baldwin and Scott (1987) concluded there was no unambiguous evidence of an important, generally valid, relationship between competition and innovative activity. Scott (1993) showed that once industry and firm effects - proxies for technology opportunities – have been taken into account, the effect of seller concentration on innovation becomes statistically insignificant. In addition, it is often argued that a monopolist has an incentive to suppress subsequent innovation by other firms (e.g. Weinberg, 1992). In all, decades after Schumpeter's (1934; 1942) initial work the relationship between competition and innovation is still under debate (Clement, 2003).

One fundamental problem in the analysis of competition and innovation is that the former concept is rather abstract and cannot be measured directly. Conventional

approaches in industrial organization (IO) literature are dominated by models in which competition is measured using structural variables indicative of the outcomes of competitive processes, usually including easy to measure indicators such as concentration (e.g. Herfindahl-Hirschmann index, C4-ratios), price-cost margins and numbers of entrants in industries (Tang, 2006). Most empirical IO studies test the Schumpeterian hypotheses with data on R&D intensity and concentration. This can, however, be criticized. Scott (1993), for example, demonstrated that the effect of concentration is only a small percentage of the systematic variance in R&D intensity across firms. In general, traditional IO indicators give information only about results of competition and not the process behind competition (Kemp, Mosselman & van Witteloostuijn, 2004). Potential distinctions between various types of competition are usually ignored. In fact, the logic of the competitive process - the interaction between market parties - and how this competitive process is perceived by industry members is one of the major deficiencies in IO-based theories (Johnson & Hoopes, 2003). This implies that alternative measures of competition are needed to better understand how competition and innovation are related.

This paper empirically studies the connection between firms' innovative intentions and various types of competition. We argue that both competition and innovation have multiple dimensions and that firms' innovative intentions can be associated with different competitive forces. In support of this argument we use three new, firm-specific measures of competition, measured in a survey of 2,281 Dutch SMEs. Our measures are related to various competitive forces including internal rivalry i.e. competition between incumbent firms in an industry, bargaining power of suppliers and bargaining power of buyers. We also argue that firms' competitive reactions are contingent on their internal competences and assets (cf. Gatignon & Reibstein, 1997). More specifically, we hypothesize that firms with a strategic focus on innovation are less sensitive to competitive pressures, implying that the connection between competition and innovative intentions diminishes. In all, the paper gives a more fine-grained picture of how competition and firms' innovative intentions are related, and the circumstances that influence this relationship.

The next section discusses relevant theory and develops hypotheses. The third section presents our survey data and variables, including innovation and competition indicators. We also present some descriptive statistics to explore differences across industries and size classes. The fourth section then develops a range of logistic regression models to test our hypotheses. The final section, section five, concludes.

2. Theory and hypotheses

Unlike many previous studies that used indicators based on industrial statistics, this paper follows a relatively new line of research in industrial organization by using data on firms' perceptions of their competitive environment (cf. Tang, 2006). What might be the value added of adding new measures of competition to the long list already available in IO? Our central argument is the trivial observation that, at the end of the day, competitive decisions are made by human beings. The connection between competition and innovation can be better understood by incorporating insights from psychology i.e. entrepreneurs' perceptions of competition and the contingencies that influence the connection between competition and innovation behaviour. Such a 'humanized' view of decision-making is far from new. It has in fact a long tradition in business literature, a classical example being the behavioural theory of the firm as developed in the 1950s

and 1960s (e.g. Cyert & March, 1963) – a theory that inspired modern evolutionary economics to introduce a routine-driven conception of the firm in models of competition, where satisfying - rather than maximizing - behaviour rules firm-level decision-making (e.g. Nelson & Winter, 1982). Yet, in the analysis of competition and innovation such a view is relatively new.

Tang (2006) argues that perception-based measures are a significant departure from current IO literature for three reasons. First, for a given competitive environment, different firms may have different perceptions about the degree of competition they face. Prudent managers are more likely to maintain higher levels of perceptions about the degree of competition and to undertake innovation efforts against potential competitors. Differences in perceptions partly explain why some firms undertake more innovation activities than others in the same industry in a given competitive environment. Second, perception-based measures capture firm-specific competition. Firms, even in the same industry, may produce different products or compete in different product markets. Thus, the degree of firm-specific competition may not be measured correctly using traditional statistics at the level of industries. Finally, perception-based measures reflect not only competition from domestic markets but also competition from overseas markets. This is an important consideration for many Dutch firms. The Netherlands clearly is an open economy depending heavily on foreign trade (Bangma, 2005).

Competitive forces

Perception-based measures of competition can take different perspectives. Rather than taking a holistic view of competition (e.g. Porac & Thomas, 1994; Hodgkinson, 1997) we here dispose of data on various competitive forces that firms encounter in their value chain. We distinguish between internal rivalry (among incumbent firms within the industry), the bargaining power of suppliers and that of buyers. These forces are all part of Porter's (1979) framework of competion. Initially, he listed a number of structural characteristics of industries that indicate intense competition, such as a high number of incumbent firms, low entry barriers and a high market growth rate. Such indicators do not, however, suffice to capture the nature of competition. Structural elements of industries provide only limited information as they indicate only the outcomes of competitive processes. Porter (1979) suggested his well-known five forces as a framework to analyse the nature of competition. It summarizes decades of industrial organisation research on industries' comperitive intensity in an easy-to-comprehend scheme. We now elaborate on the three forces investigated in this paper: internal rivalry, supplier power and buyer power. Other forces include the threat of new entrants and the threat of substitute products. Due to data restrictions (see section 3) these forces remain unexplored here.

Rivalry among existing competitors takes the familiar form of 'jockeying for position' - using tactics such as price competition, new product development and advertising (Porter, 1979, p. 142). Internal rivalry is the extent to which incumbent firms in an industry frequently and vigorously engage in outwardly manifested competitive actions in their search for competitive advantage (Pecotich, Hattie & Low, 1999). It is associated with a number of factors (Porter, 1979):

- Incumbent firms are numerous or are roughly equal in size and power.
- Industrial growth is slow, precipitating fights for market share that involve expansion-minded members.

- Products or services lack differentiation or switching costs (which lock-in buyers and protect one combatant's customers from being raided by another).
- Fixed costs are high or the product is perishable, creating strong temptation to cut prices when demand slackens.
- Capacity is normally augmented in large increments. Such additions disrupt the industry's supply-demand balance and often lead to periods of overcapacity and price cuts.
- Exit barriers are high. Exit barriers, like very specialized assets or management's loyalty to a particular business, keep companies competing even though they may be earning low or negative returns on investment. Excess capacity continues to exist, and the profitability of the healthy competitors suffers as the sick ones continue to survive .
- Rivals are diverse in strategies, origins, and 'personalities'. They have different ideas about how to compete and continually run into each other head-on.

The bargaining power of suppliers is defined as the extent to which suppliers are able to exert influence and affect the firm's profitability and general well-being (Pecotich et al., 1999). Suppliers can exert bargaining power on participants in an industry by raising prices or reducing the quality of purchased goods or services. In so doing they may squeeze the profitability out of an industry that is unable to recover cost increases in its own prices. Supplier power is more likely if (Porter, 1979):

- The number of suppliers is limited, and more concentrated than the industry to which it sells.
- Their products are unique or at least differentiated or suppliers have built up switching costs (e.g. costs that buyers face when changing suppliers, such costs arising from tailor-made product specifications, heavy investments in specialized ancillary equipment or in learning how to operate a suppliers' equipment, connected production lines etc).
- Suppliers are not obliged to contend with other products for sale to the industry (e.g. car navigation devices nowadays also compete with mobile phones and PDA's).
- Suppliers pose a credible threat of integrating forward into the industry's business.
- The industry is not one of the supplier group's important customers. If the industry is an important customer, suppliers' fortunes will be closely linked to those of the industry, and they will want to protect the industry through reasonable pricing and assistance in activities like R&D and lobbying.

Clients' bargaining power relates to the extent to which clients can exert influence and affect the firm's profitability and general well-being (Pecotich et al. 1999). Like suppliers, customers may force down prices, demand higher quality or free services or play competitors off against each other - all at the expense of industry profits. Buyers are more powerful if (Porter, 1979):

- They are concentrated or purchase in large volumes. This simply raises the stakes to keep capacity filled.
- The products they purchase from the industry are standard or undifferentiated. Buyers, sure that they can always find alternative suppliers, may easily play one company off against another.

- Their purchases form a component of their own products and represent a significant fraction of their costs. Such buyers are more likely to shop for a favourable price and purchase selectively.
- Buyers earn low profits. This creates strong incentives for lowering their purchasing costs. Highly profitable buyers, however, are generally less price sensitive.
- The industry's product is unimportant for the quality of the buyers' products or services. Where the quality of the buyers' products is very much affected by the industry's product, buyers are generally less price sensitive (e.g. medical equipment).
- The industry's product does not save buyers' money. Where products or services pay for themselves many times over, buyers are rarely price sensitive; rather, they are interested in quality (e.g. investment banking, fiscal consultancy services).
- The buyers pose a credible threat of integrating backward to make the industry's product.

Our research thus follows Porter's (1979) proposition that competition not only relates to the behaviour of incumbent firms, but also includes forces in firms' broader environment. By investigating two more dimensions of competition - the bargaining power of suppliers and buyers - we are able to develop and test more detailed hypotheses on how various types of competition relate to firms' innovative intentions[1].

Connection with innovation

A first, general issue to address is whether we should expect a positive or negative connection between competition and innovation indicators. We recall that in his initial work Schumpeter (1934) implicitly suggested a positive relationship, representing innovation as a consequence of entrepreneurial behaviour, and originating from competitive small firms challenging the status quo. As discussed above however, Schumpeter's later work (1942) predicted that competition can also switch off firms' innovative efforts. Monopoly power provides firms with better opportunities to achieve positive results from innovative efforts.

Both Schumpeterian hypotheses represent theoretical regimes i.e. they are both found in daily business depending on specific industrial circumstances such as concentration and entry rates (Malerba & Orsenigo, 1995). In our current research among Dutch SMEs, we hypothesize a positive connection between competition and firms' innovative intentions. Our data include only firms with fewer than 100 employees (see next section). In the Netherlands such firms are located in environments which can be characterized as fragmented markets with many incumbent firms. In other words, the relevant market form is monopolistic competition rather than an oligopoly or monopoly. In such environments, incentives to terminate innovative efforts as a consequence of losing monopoly power (from increased competition) are not very likely[2].

[1] Another argument to use Porter's framework is that it is well-known in the world of business. Measurement of distinct forces (rather than a holistic competition measure) is more specific and relates better to respondents' experiences.

[2] Of course, for large firms or specific industries such as manufacturers of medicines, the situation could be different. In section 5 we elaborate on the generalizability of our results.

Once competitive forces have been identified and perceived as a threat, firms need to decide if and how to respond. The nature and intensity of competitive forces determine firms' potential profitability and are of greatest importance in deciding how to act. Optimal responses are usually contingent on specific types of forces (Porter, 1979). Here, we propose that different types of competition are connected with different types of innovation. This paper focuses on the widely accepted distinction between innovations related to products and services and innovations related to processes (cf. Tidd, Bessant & Pavitt, 2001). We propose that some competitive forces relate to intended product innovation while others are associated with intended process innovation.

As far as internal rivalry is concerned we primarily expect a positive connection with intended product innovation. When firms face aggressive moves from other incumbent firms a likely response is to differentiate one's current products or services, resulting in stronger intentions to invest in product innovation. By doing so firms can decrease the risk of becoming involved in bitter price wars . Previous work gives various arguments in support of this proposition. Cabral (2000) argues that internal rivalry diminishes the degree of collusive power between incumbent firms, making them more eager to differentiate their offerings by developing new products or services. Bruins (2006) recently added that a large majority of SMEs prefers a strategy of differentiation rather than offering low prices. Drawing on a descriptive survey of Dutch SMEs he finds that 84% prefers to be distinctive by developing new products or by offering extra services. Only 8% prefers a low-cost strategy, implying that most SMEs will try to circumvent cutting prices and make product innovation a more likely response.

A connection between perceived internal rivalry and intended process innovation is less evident. For reasons similar to those mentioned above, process innovations aimed to realize cost savings in order to lower output prices will not be favoured by small business owners. Due to their size most SMEs have fewer options to invest in process innovations anyway; small firms' work processes are often rather simple. Indeed, it has been recognized that larger firms have greater incentives to improve their internal processes, which in conjunction with economies of scale should stimulate larger firms to make greater efforts towards process innovation than their smaller counterparts (Tang, 2006; Benavente, 2006). So

Hypothesis 1: Perceived internal rivalry is positively connected with firms' intentions to invest in product innovation.

For supplier power we expect a positive connection with intended process innovation. The bargaining power of suppliers influences the marginal costs of producing outputs and thereby firms' competitive posture in their output markets (Cabral, 2000). In most markets customers are far from indifferent to price increases, therefore incumbent firms are usually unable to compensate for supplier power by increasing their own prices (Porter, 1979). Because investments in new products or services are less likely - such initiatives would target buyers rather than suppliers - incumbent firms probably need to accept the restrictions that suppliers impose on them by adjusting their processes i.e. by attempting alternative cost savings or adjustments in their production processes to become less dependent on their suppliers in the long run.

One example is the recruitment of IT workers by Dutch firms. One decade ago these workers were very scarce. Dutch firms tried to circumvent this scarcity by various

process innovations, including less restrictive and very creative recruitment procedures, investing heavily in company training programs and employment conditions, etc. A few years later the IT market suffered from a severe recession, and consequently the demand for IT workers dropped substantially and most initiatives to deal with the scarcity were terminated (CBS, 2004). In all, our hypothesis is

> *Hypothesis 2: Perceived bargaining power of suppliers is positively connected with firms' intentions to invest in process innovation.*

For the bargaining power of buyers, our reasoning is similar to that for internal rivalry. Buyer power is positively correlated with the demand elasticity (Cabral, 2000), implying that compared to normal buyers, powerful buyers are more sensitive to price differences. In the case of powerful buyers we hypothesize that firms prefer to prevent price cuts by differentiating their products or services from other incumbent firms. This implies that that investments in new products or services are more likely. Another reason to hypothesize a positive connection is that firms will be willing to meet their customers' wishes by developing and introducing tailor-made, specific products as long as specific boundaries (e.g. excessive investments, danger of discontinuity, etc.) are met. In industrial organization studies, demand factors have been frequently identified as an important determinant of innovation. Schmookler (1966) first formulated such rationale known as the 'demand pull hypothesis'. Bruins (2006) recently found that Dutch SMEs strongly prefer to meet their customers' demands by developing new products or offering extra services, rather than by lowering their prices. The latter response is considered as 'poisoning' the market and believed to create a less favourable business environment for the firm itself. So

> *Hypothesis 3: Perceived bargaining power of buyers is positively connected with firms' intentions to invest in product innovation.*

Interaction with innovation strategy

As previous studies found mixed results (Clement, 2003), a positive connection between competition and innovation is far from default and probably contingent on other factors. In his early article Porter (1979) had already discussed that the nature of competitive responses should be contingent on firms' internal strengths and weaknesses (p. 143). Any plan of action should position the firm so that its capabilities provide the best response against relevant competitive forces. This creates opportunities for many hypotheses on specific factors that can interact with perceived competition to explain when and how innovative responses are most likely. An obvious example is the availability of innovation resources such as time, money and relevant knowledge. A lack of such resources would diminish the connection between any kind of competition and firms' innovative intentions (cf. Gatignon & Reibstein, 1997)[3].

This paper empirically explores the impact of one specific internal capability, namely the presence of an innovation strategy. When innovation is part of an organization's strategy this provides direction for the activities that will be developed in the future (Tidd, Bessant & Pavitt, 2001). Such firms are more likely to realize

[3] Similar hypotheses have been proposed and tested in the literature on networking and innovation. For example Lee, Lee and Pennings (2001) empirically demonstrated that firms' internal capabilities (e.g., technological capabilities, financial resources) interact with external linkages to better predict the performance of technology-based ventures.

innovative outputs (Hadjimanolis, 2000), so a significant connection between innovation strategy and firms' innovative intentions is expected.

We here propose that innovation strategy is also an interaction variable that influences the association between competition and firms' innovative intentions. Firms with a strategic focus on innovation will be less likely to directly respond to competitive pressures. If firms maintained an innovation strategy, the connection between competition and innovation would decrease – for two reasons. First, strategy determines where firms are going in the coming years and how they are going to get there (Campbell, Stonehouse & Houston, 1999). An innovation strategy stresses that new product and process development is among the overall priorities in how the organization will operate. The more a firm's strategy stresses innovation as an important objective, the more their managers - and probably also their employees - will be inclined towards the initiation and implementation of innovations. Such firms will innovate anyway, no matter what competitive forces are applicable. Second, we stress that one major activity in any strategic exercise has to be an analysis of the organization's environment, including competitive forces (Campbell et al. 1999). The presence of innovation strategy indicates that an analysis of competition has already been made. Innovative responses to perceived competition will already have been discounted in the current strategic planning and objectives for the forthcoming period, again leaving fewer possibilities for a direct association between competitive pressures and innovative intentions. We therefore hypothesize

Hypothesis 4: The connection between internal rivalry and firms' intentions to invest in product innovation is stronger when firms have no innovation strategy, and vice versa.

Hypothesis 5: The connection between supplier power and firms' intentions to invest in process innovation is stronger when firms have no innovation strategy, and vice versa.

Hypothesis 6: The connection between buyer power and firms' intentions to invest in product innovation is stronger when firms have no innovation strategy, and vice versa.

3. Data

Our data are taken from a survey conducted by EIM Business and Policy Research, a Dutch institute specialized in small business research. The survey commmissioned by the Dutch ministry of Economic Affairs, aimed to measure how SMEs organize their business processes. Its topics included innovation, marketing, strategy, human resource management, planned investments, and also a number of questions about perceived competition. The survey was motivated by the fact that the organization of business processes is not systematically recorded in publicly funded sources in the Netherlands - and certainly not for SMEs. Although the survey was not specifically executed for the current paper, its data are well suited to empirically test our hypotheses.

The survey was carried out in June 2006, over a period of four weeks, by means of computer assisted telephone interviewing (CATI). All respondents were responsible for day-to-day business processes i.e. the owner/entrepreneur or general manager. An initial sample of 5,500 firms was drawn from the entire population of SMEs in the Netherlands, as available from the Chamber of Commerce. Small and medium-sized firms were defined as firms with no more than 100 employees (Bangma, 2005). The sample was disproportionally stratified across 12 industries and three size classes.

Responses were obtained from 2,281 persons, a response rate of 41%. Table 1 shows how the respondents were distributed.

Table 1. Number of respondents across type of industry and size class

Type of industry	*NACE-codes*	*Size class: …employees*			*Total*
		1-9	*10-49*	*50-99*	
Agriculture	01, 02, 05	109	50	6	165
Low-tech manufacturing	15-22, 25-28, 34-37	236	128	29	393
High-tech manufacturing	23, 24, 29-33	64	44	11	119
Construction	45	99	49	9	157
Wholesale trade	51	169	93	16	278
Retail trade	50, 52	156	74	8	238
Hotels, restaurants and catering	55	52	25	6	83
Transport	60-64	120	55	20	195
Knowledge-intensive services	72, 73, 74.2	68	44	7	119
Other business services	70-71, other 74	198	115	29	342
Personal services	92-93	71	38	6	115
Financial services	65-67	44	28	5	77
Total		1,386	743	152	2,281

A comparison of the distribution of respondents and non-respondents by industrial sector indicates that there is no non-response bias present. A χ^2-test between the distributions reveals no significant differences at the 5% level ($p = 0.33$). For size class however, responses are somewhat selective. Medium-sized enterprises (10-49 and 50-99 employees) were less willing to participate compared to entrepreneurs in smaller enterprises ($p(\chi^2) = 0.01$). This is not surprising as small businesses are generally most easy to contact. As the survey was disproportionally stratified, this selectiveness is not considered problematic (see hereafter). A similar χ^2-test on the joint distribution for industrial sector and size class, as shown in table 1, appeared to be insignificant ($p = 0.07$) indicating that non-responses are not a serious problem.

The sampled firms represent a much larger group of small firms than other business surveys. The Dutch version of the Community Innovation Survey for example excludes firms below the threshold of 10 employees (CBS, 2005). In the sample used here more than 60% of the data was collected from such firms (=1,386/2,281). With regard to the relative size class distribution of sample firms however, small firms are still under-represented. In the reality of Dutch business small firms represent 83% of the population (Bangma, 2005). Larger firms had been chosen to be over-represented in order to enable comparisons between size classes.

Table 1 also shows that a majority of the sample firms are from service industries. As in many other developed countries, the Dutch economy is increasingly service-based and knowledge-based. Service firms nowadays represent the majority of the business population (Bangma, 2005). Yet again, some industries were over-sampled at the expense of others. It had been decided to collect a larger share of respondents from relatively innovative industries, including high-tech manufacturing, wholesale trade, transport (including telecommunications), knowledge-intensive services and other business services (including consultancies). These industries receive most attention from policy makers and are 'heavy users' of Dutch innovation policy instruments. Although the given stratification of the sample inevitably distorts the validity of our descriptive statistics and aggregated observations, we do not expect that the legitimacy of the causal analyses presented in the next sections has been seriously compromised.

Variables

Table 2 presents the variables that we use to empirically test our hypotheses. For innovative intentions we dispose of two indicators, representing firms' intentions to invest in the development or implementation of new products/services (product innovation), and intentions to develop or implement new production processes (process innovation). Both questions were limited to the coming year's intentions and had binary answers (yes/no).

Table 2. List of variables

Variable	*Description and values*[Ψ]
Intended product innovation	Firm intends to invest in product innovation in the coming year, i.e. development or implementation of new products/services (yes/no)
Intended process innovation	Firm intends to invest in process innovation in the coming year, i.e. development or implementation of new production processes (yes/no)
Innovation strategy (IS)	Firm has an innovation strategy, i.e. regards constant renewal of products and production processes as an important part of its business strategy (yes/no)
Internal rivalry (IR)	Mean score of three items (α = 0.73, mean r = 0.47, lowest IRC = 0.51): • Firms in our market compete intensively, as a result of which our market share is threatened (totally disagree/ disagree/ neither agree nor disagree/ agree/ totally agree). • Our margins are squeezed because of aggressive marketing by our competitors (totally disagree/ disagree/ neither agree nor disagree/ agree/ totally agree). • Internal rivalry among incumbent firms in our market limits our profitability… (not at all/ marginally/ some extent/ large extent/ very large extent).
Supplier power (SP)	Mean score of three items (α = 0.70, mean r = 0.44, lowest IRC = 0.47): • Our suppliers are powerful and they indeed use their power (totally disagree/ disagree/ neither agree nor disagree/ agree/ totally agree). • We need to remain loyal to our suppliers even if they raise their prices or lower the quality of their products (totally disagree/ disagree/ neither agree nor disagree/ agree/ totally agree). • Bargaining power of suppliers limits our profitability… (not at all/ marginally/ some extent/ large extent/ very large extent).
Buyer power (BP)	Mean score of three items (α = 0.77, mean r = 0.53, lowest IRC = 0.57): • Our buyers are in a position to negotiate our terms of delivery and prices (totally disagree/ disagree/ neither agree nor disagree/ agree/ totally agree). • Our buyers are tough negotiators (totally disagree/ disagree/ neither agree nor disagree/ agree/ totally agree). • Bargaining power of buyers limits our profitability… (not at all/ marginally/ some extent/ large extent/ very large extent).
Type of industry	Dummies for 11 industries (low-tech manufacturing; high-tech manufacturing; construction; wholesale trade; retail trade; hotels, restaurants and catering; transport; knowledge-intensive services; other business services; personal services; financial services) with agriculture as the reference group
Firm size	Number of employees in full-time equivalents, log transformed

[Ψ] Dichotomic responses are coded as 'yes' = 1 and 'no' = 0. Responses on 5-point Likert scales are coded from 1 (in case of 'totally disagree' and 'not at all') to 5 ('totally agree' and 'very large extent').

Both innovation indicators deal explicitly with intentions rather than realized innovations. In this respect our analysis provides a more realistic view, i.e. it makes more sense that perceived competition is connected with innovative intentions than with realized innovations. Past research has repeatedly demonstrated that today's intentions are most important for future behaviour (e.g. Ajzen & Fishbein, 2005). In contrast,

innovations which have already been realized relate to past behaviour, making it difficult to claim that innovation is a consequence of perceived competition[4].

Perceived competition was measured using multiple-item, Likert-type scales. As shown in table 2 each force was operationalized with three items. The first two items are statements and relate to the relevant force. Firms were asked to evaluate internal rivalry, supplier power and buyer power by indicating their opinions on five-point scales ('totally disagree - totally agree'). Within each measure a third item measured the perceived impact of the force on the firm's profitability. This question was also answered on a five-point scale ('not at all - to a very large extent'). All items were taken from the work of Kemp et al. (2004) who made the first attempt to develop a multi-dimensional measure of perceived competition for application by statistical offices. Various reliability statistics were calculated to assess internal consistency. We computed Cronbach's α, mean correlations between the items (mean r) and all item-rest correlations (IRCs). The last two criteria were adopted because α tends to vary with the number of items in a scale (Cortina, 1993). Recommended critical values are 0.70 for α, 0.40 for mean r, and 0.30 for any item-rest correlation (Cortina, 1993; Hair, Anderson, Tatham & Black, 1998). Table 2 shows that all measures satisfy these criteria and are sufficiently reliable.

We also found that the three measures are distinct and reflect truly different aspects of competition. Using the Factor procedure in SPSS, we applied exploratory factor analysis with oblique rotation to explore the dimensionality of the items (cf. Hair et al., 1998)[5]. First, pre-analysis tests for the suitability of data for factor analysis were computed. The Kaiser-Meyer-Olkin (KMO) measure for sampling adequacy was 0.78 and the Bartlett test of sphericity was significant at $p < 0.001$, indicating the data were suitable for factor analytic procedures. Next, exploratory factor analysis suggested three dimensions with eigenvalues greater than unity. After oblique rotation the anticipated patterns of factor loadings were found. All loadings were > 0.50 on their specific force (as specified in table 2). Cross-loadings were always smaller than 0.20. These results are not presented here due to space limitations, but they are available from the authors on request.

Innovation strategy, the proposed interaction variable, was measured with a single, dichotomous question indicating whether the firm regards constant renewal of products and production processes as an important part of its business strategy. Previous work has demonstrated that this indicator correlates significantly with many other innovation capability indicators (De Jong & Marsili, 2006). Finally, variables used as controls included industry dummies and firm size. Industry dummies are proxies for the organization's larger economic environment, reflecting technological, demographic and socio-economic opportunities (Shane, 2003). Industry effects have been found to be important in explaining variance in innovative activity (e.g. Baldwin & Scott, 1987; Scott, 1993). For firm size, large firms are generally perceived to be more innovative than small firms because large firms are more capable of financing innovation projects and stand to gain more from their investments. They tend to be better at securing innovation resources, spreading the risks associated with innovation projects, and

[4] Of course the data are still cross-sectional, so we cannot claim any causal inferences (also see section 5).

[5] Since our primary objective was to identify latent dimensions of competition (rather than data reduction), this is prefered over principal component analysis and orthogonal rotation (cf. Hair et al., 1998).

retaining specialized workers (Vossen, 1998; Nooteboom, 1994). For the sampled firms, the mean firm size is 13.3 employees in full-time equivalents, with a standard deviation of 17.8. These raw data were first log transformed, the reasoning being that an additional employee probably has a greater impact on the innovation practices and intentions of smaller firms than on those of larger ones.

Descriptive statistics

Table 3 provides the means, standard deviations and correlations for the main variables in our analyses (sector dummies and firm size have been excluded due to space restrictions). The share of SMEs with intentions to invest in product innovation is slightly lower than the corresponding share for process innovation. This reflects that small firms in general have relatively simple internal processes with fewer opportunities to benefit from process innovation .

Table 3. Descriptive statistics of main variables (n=2,281)

Variable	Mean	SD	1	2	3	4	5
1 Intention for product innovation	0.56	0.50					
2 Intention for process innovation	0.46	0.50	0.30**				
3 Innovation strategy	0.54	0.50	0.42**	0.34**			
4 Internal rivalry	3.06	0.99	0.07**	0.02	0.06*		
5 Supplier power	2.72	0.96	0.03	0.07**	0.03	0.34**	
6 Buyer power	3.05	0.98	0.13**	0.11**	0.14**	0.38**	0.27**

** $p < 0.001$; * $p < 0.01$.

About half of the sampled firms maintain an innovation strategy i.e. regard innovation as an important aspect of their business strategy. As for the competitive forces, it seems that the sampled SMEs perceive more internal rivalry and buyer power than bargaining power of suppliers (mean scores of 3.06, 3.05 and 2.72).

As we expected that perceived competition, innovative intentions and the presence of innovation strategies would vary across industries and size classes, we further explored the differences between these groups of firms. Table 4 presents the results.

Table 4. Comparison between industries and size classes

	n	*Intended product innovation*	*Intended process innovation*	*Innovation strategy*	*Internal rivalry*	*Supplier power*	*Buyer power*
Type of industry:							
Agriculture	165	0.41	0.43	0.44	3.05	2.82	3.38
Low-tech manufacturing	393	0.55	0.46	0.54	3.00	2.80	3.10
High-tech manufacturing	119	0.69	0.55	0.71	2.84	2.72	3.28
Construction	157	0.41	0.29	0.36	3.29	2.85	3.29
Wholesale trade	278	0.60	0.48	0.56	3.21	2.85	3.24
Retail trade	238	0.52	0.34	0.47	3.40	3.03	2.66
Hotels, restaurants and catering	83	0.63	0.48	0.54	2.77	2.71	2.38
Transport	195	0.55	0.45	0.47	3.33	2.93	3.17
Knowledge-intensive services	119	0.76	0.60	0.75	2.77	2.26	3.17
Other business services	342	0.54	0.49	0.56	2.87	2.35	3.02

	n	*Intended product innovation*	*Intended process innovation*	*Innovation strategy*	*Internal rivalry*	*Supplier power*	*Buyer power*
Personal services	115	0.68	0.45	0.65	2.72	2.48	2.56
Financial services	77	0.49	0.58	0.55	3.13	2.73	2.90
F-value (firm size as control variable)		6.1**	4.3**	6.7**	10.6**	12.6**	15.6**
Size class:							
1-9 employees	1,386	0.49	0.34	0.45	2.98	2.72	2.92
10-49 employees	743	0.64	0.59	0.64	3.17	2.73	3.22
50-99 employees	152	0.78	0.83	0.80	3.26	2.77	3.45
F-value (industry as control variable)		22.3**	60.9**	34.9**	10.8**	0.4	19.3**
Total	2,281	0.56	0.46	0.54	3.06	2.72	3.05

** $p < 0.001$.

We analyzed significant differences between industries with analyses of covariance, drawing on the GLM procedure in SPSS. We entered log transformed firm size as a covariate to account for the fact that among industries firms also differ in their size. For example, manufacturers are generally bigger than firms in services industries (Bangma, 2005). Even after controlling for size we find large and significant differences. For our indicators on innovative intentions, we find higher than average scores for a number of industries, high-tech manufacturing and knowledge-intensive services being the most striking ones. Below average performers include agricultural, construction and retail firms. Similar patterns are found for innovation strategy. These findings are common sense; many previous studies demonstrated that these industries consist of relatively active and passive innovators (e.g. Tidd et al. 2001; CBS, 2005; De Jong & Marsili, 2006).

Differences in our competition measures also show some plausible results. Perceived internal rivalry is highest among construction, retail and transport firms. Such firms usually offer standardized products with low switching costs. In addition, fixed costs for housing and machinery form a large share of their total expenses. This implies that within these industries rivalry between incumbent firms is likely to be relatively intense. For supplier power we find relatively high scores for retail traders, while the opposite applies to knowledge-intensive and other business services and also to personal services. Retail traders need to participate in a continuous struggle with their suppliers (e.g. manufacturers, wholesale traders) to negotiate quality, delivery and price conditions. In comparison, most service firms are labour-intensive and not very dependent on any supplier (Johne & Storey, 1998). Finally, for buyer power we find relatively high scores for agricultural firms, while retail firms, hotels and restaurants, and personal services firms do not perceive much buyer power. Large parts of the Dutch agricultural sector are still strongly regulated by cooperative societies that enforce production quota and collective prices to individual firms. In contrast retailers, hotels and restaurants and personal service providers operate on consumer markets. Most of their buyers are unable to negotiate or impose delivery conditions and prices, and are usually unwilling even to try.

Significant differences between size classes were analyzed with factorial analyses of variance (GLM procedure in SPSS). We now used industry dummies as control variables to account for the fact that firms in various size classes will not be uniform in

their industrial distribution. In sum, significant differences are found for all variables except for supplier power. Table 4 confirms that larger firms defeat their smaller counterparts in terms of innovative intentions and maintaining innovation-based strategies. As discussed above, this is in line with previous work (e.g. Vossen, 1998). Larger SMEs, for example, offer broader product ranges implying that it is more likely that investments will be made (for at least one product) in the coming year.

Perceived competition also varies with firm size (table 4). Medium-sized firms perceive more intense competition from incumbents in their industry (mean score of 2.98 for firms with 1-9 employees, versus 3.17 and 3.26 for medium-sized firms, $p < 0.001$). In general, medium-sized firms operate in relatively concentrated markets, implying that they encounter many other large firms in their environment, some of them even much bigger than themselves (Bangma, 2005). In such environments competitors' behaviour is generally better visible. Operating on a larger scale also indicates that in all probability more standardized, undifferentiated products are sold and also that larger firms may face higher sunken costs making them more committed to maintaining a position in their current markets. These issues all imply that internal rivalry can be perceived as being more severe.

In the same way perceived buyer power is also positively correlated with firm size. Differences in mean scores are significant at $p < 0.001$ (table 4). This may be due to the fact that large firms tend to deliver in larger quantities, giving their buyer a better position and incentive to negotiate. In all, innovative intentions, the presence of innovation strategies and perceived competition appear to differ between industries and size classes. Most differences are well interpretable. For the competitive forces, the differences also demonstrate that our measures are able to recover differences in the perceptions of competitive forces across groups of firms.

4. Results

This section first sets up a range of binary logistic regression models to test our hypotheses on intended product innovation. Next, similar analyses are made for intended process innovation.

Binary logistic regression is a form of regression which is used when the dependent is a dichotomy and the independents are of any type (Verbeek, 2004). It can be used to predict a dependent variable on the basis of continuous and/or categorical independents, to understand the impact of covariate control variables, to determine model fit and to assess interaction effects. Logistic regression applies maximum likelihood estimation after transforming the dependent into a logit variable (i.e. the natural log of the odds of having innovative intentions or not). To examine the connection between firms' innovative intentions and perceived competition, we thus estimate the influence of various competitive forces on the probability that firms intend to invest in product and process innovation.

As in OLS regression, a major assumption is that independent variables do not suffer from multicollinearity. Table 3 already demonstrated that although there are significant correlations between some pairs, our independent variables are sufficiently distinct to be used separately in the analyses. Pearson correlations do not exceed 0.38. This implies that no independent variable shares more than 15% of the variance with any other.

The success of logistic regression can be assessed with a goodness-of-fit test based on the transformed loglikelihood value –2LL. It is interpreted in terms of 'smaller

is better'. After adding variables in subsequent steps (e.g. competitive forces) the change in the transformed loglikelihood (Δ-2LL) is related to Δdf (degrees of freedom) and tested against a χ^2-distribution (Verbeek, 2004). Other frequently-used indicators to evaluate the results include Wald tests (to test the significance of individual independent variables), the hit rate and Nagelkerke's R^2. Neither of the last two indicators directly test goodness-of-fit; the hit rate represents the percentage of correctly classified cases on the dependent variable. It indicates whether additional independent variables enable a better prediction of the binary dependent i.e. firms' innovative intentions[6]. Nagelkerke's R^2 is a pseudo R^2-statistic with a theoretical maximum of 1.0, indicating the strength of association in the overall model.

Models of intended product innovation

To test hypotheses 1, 3, 4 and 6 we conducted a range of binary logistic regressions with intended product innovation as the dependent variable. These analyses were make with the logistic regression command in SPSS and included five models in which various independent variables were subsequently entered:

- Model I was an empty model (intercept only) to obtain baseline values for the transformed loglikelihood value (-2LL) and the hit rate.
- Model II included all control variables as independent variables: industry dummies, log transformed firm size and the presence of an innovation strategy.
- Model III added measures for the three competitive forces: internal rivalry, supplier power and buyer power. This model provides a test of hypotheses 1 and 3.
- Model IV added an interaction term between innovation strategy and internal rivalry. This model provides a test of hypothesis 4.
- Model V added the interaction between innovation strategy and buyer power. This model tests hypothesis 6.

Our competition measures were first rescaled into centered scores and then entered into the equations. Interaction terms were computed by taking the product of innovation strategy and this mean centered competitive force. The significance of interactions can be derived from the regression coefficients of these terms, after the main effects of separate independents have been partialed out (cf. Aiken & West, 1991).

Table 5 shows the results. Without independent variables the transformed loglikelihood value is 3,128.10. In addition, 56.1% of the sampled firms is classified correctly. This is equal to the share of firms with intentions to invest in new products or services in the coming year, as reported in table 3.

Table 5. Binary logistic regression models of intended product innovation (n=2,281)

	Models				
	I	*II*	*III*	*IV*	*V*
Parameter estimates:					
Constant		-1.62**	-1.62**	-1.60**	-1.62**
Industry: low-tech manufacturing		0.46^	0.52^	0.52^	0.52^
Industry: high-tech manufacturing		0.75*	0.82*	0.81*	0.82*
Industry: construction		0.11	0.11	0.10	0.11
Industry: wholesale trade		0.68*	0.70*	0.68*	0.70*

[6] The hit rate cannot be used as goodness-of-fit measure because it ignores actual predicted probabilities and instead uses dichotomized predictions based on a cutoff (Verbeek, 2004).

	Models				
	I	*II*	*III*	*IV*	*V*
Industry: retail trade		0.44	0.53^	0.51^	0.53^
Industry: hotels, restaurants and catering		0.86*	1.04*	1.04*	1.04*
Industry: transport		0.57^	0.59^	0.57^	0.59^
Industry: knowledge-intensive services		1.19**	1.25**	1.25**	1.25**
Industry: other business services		0.39	0.47^	0.46^	0.47^
Industry: personal services		0.91*	1.07**	1.06**	1.07**
Industry: financial services		0.15	0.22	0.21	0.23
Log firm size		0.29**	0.26**	0.26**	0.26**
Innovation strategy (IS)		1.60**	1.57**	1.58**	1.57**
Internal rivalry (IR)			0.07	0.17^	0.07
Supplier power			0.00	0.00	0.00
Buyer power (BP)			0.15^	0.14^	0.15^
Interaction: IS*IR				-0.20^	
Interaction: IS*BP					-0.01
Model fit:					
-2LL	3,128.10	2,556.88	2,544.31	2,539.94	2,544.29
Δ -2LL		571.22	12.57	4.37	0.02
Δ df		13	3	1	1
significance		**	*	^	
Correctly classified cases	56.1%	71.0%	73.9%	74.4%	74.0%
Nagelkerke R^2		0.25	0.26	0.27	0.26

** p < 0.001; * p<0.01; ^ p<0.05.

Model II adds our control variables to the equation. This significantly diminishes the transformed loglikelihood value (Δ -2LL = 571.22 with Δdf = 13, p < 0.001), implying that when taken together, the independents are linearly related to the log odds of firms' intentions to invest in product innovation. The hit rate increases to 71.0% while Nagelkerke's R^2 is 0.25, suggesting a reasonable association between our controls and intended product innovation. Wald tests on the individual parameters confirm some of the differences between industries and size classes we reported on earlier e.g. high-tech manufacturers and knowledge-intensive service firms are much more likely to have innovative intentions (compared to agricultural firms), and firm size is also a strong and positive predicator. As we expected innovation strategy also very strongly increases the probability of having intentions to invest in new products (b = 1.60, p < 0.001).

Model III provides a test of hypotheses 1 and 3 by entering measures of the competitive forces. Goodness-of-fit again improves significantly (Δ-2LL = 12.57 with Δdf = 3, p < 0.01) while the hit rate and Nagelkerke's R^2 also improve. From the Wald tests we conclude that the bargaining power of buyers makes a significant contribution to the odds of having innovative intentions for product innovation (b = 0.15, p < 0.05). Thus, hypothesis 3 is confirmed. Besides, as we expected the parameter for supplier power is insignificant (b = 0.00), reflecting that firms do not invest in new products to cope with the bargaining power of their suppliers. Finally, we find no positive influence of internal rivalry. The logistic regression coefficient is positive (b = 0.07) but insignificant, so in other words we find no direct association between competition with

incumbent firms and intentions to invest in product innovation. Hypothesis 1 is rejected[7].

Model IV tests the fourth hypothesis by entering the interaction term between innovation strategy and internal rivalry. The transformed log likelihood value decreases significantly (Δ-2LL = 4.37 with Δdf = 1, $p < 0.05$). Wald tests on the individual parameters reveal a negative sign for the interaction term ($b = -0.20$, $p < 0.05$). To further analyze the significant interaction effect, the regression equation can be rearranged in simple regressions given conditional values of innovation strategy. By evaluating the parameter estimates in case an innovation strategy is present (versus lacking), different parameters estimates are obtained for the connection between perceived internal rivalry and intentions for product innovation (cf. Aiken & West, 1991). It appears that if firms do not maintain an innovation strategy (value = 0), the parameter estimate of internal rivalry is positive and significant ($b = 0.17$, $p < 0.05$). In contrast, if firms do maintain an innovation strategy (value = 1) the estimated coefficient becomes insignificant ($b = -0.03$, $p > 0.05$). So in all the connection between internal rivalry and firms' intentions for product innovation is moderated by the presence of an innovation strategy. A positive connection is found only if firms have no innovation strategy and vice versa. Hypothesis 4 is confirmed.

Model V provides a test of hypothesis 6 on the interaction between innovation strategy and buyer power. Here, adding the interaction term does not improve the goodness-of-fit (Δ-2LL = 0.02 with Δdf = 1, $p > 0.05$). The hit rate and pseudo R^2 remain almost identical as well. Buyers' bargaining power is appararently directly connected to firms' intentions to invest in product innovation, but no interaction effect is found. Hypothesis 6 is rejected.

Models of intended process innovation

An identical procedure was followed to test hypotheses 2 and 5 . We conducted four binary logistic regressions with intended process innovation as the dependent variable. Model VI was an empty model to obtain baseline values for -2LL and the hit rate. Model VII included our control variables. Model VIII added our measures of competition to test hypothesis 2. Finally, model IX entered the interaction term of innovation strategy and supplier power to test hypothesis 5. The results are presented in table 6.

Table 6. Binary logistic regression models of intended process innovation (n=2,281)

	Models			
	VI	*VII*	*VIII*	*IX*
Parameter estimates:				
Constant		-1.71**	-1.74**	-1.74**
Industry: low-tech manufacturing		-0.12	-0.10	-0.10
Industry: high-tech manufacturing		-0.07	-0.07	-0.06
Industry: construction		-0.77*	-0.76*	-0.76*
Industry: wholesale trade		-0.03	-0.02	-0.02
Industry: retail trade		-0.51^	-0.47^	-0.47^
Industry: hotels, restaurants and catering		0.01	0.05	0.04
Industry: transport		-0.09	-0.07	-0.07

[7] We did experiment with alternative ways to test hypotheses 1 and 3. When the competitive forces are entered into the equation one-by-one, results remain identical. These results are available from the authors on request.

	Models			
	VI	*VII*	*VIII*	*IX*
Industry: knowledge-intensive services		0.20	0.26	0.26
Industry: other business services		-0.01	0.04	0.04
Industry: personal services		-0.23	-0.16	-0.16
Industry: financial services		0.45	0.50	0.50
Log firm size		0.52**	0.52**	0.52**
Innovation strategy (IS)		1.18**	1.17**	1.17**
Internal rivalry (IR)			-0.08	-0.08
Supplier power (SP)			0.11^	0.14^
Buyer power (BP)			0.05	0.05
Interaction: IS*SP				-0.05
Model fit:				
-2LL	3,146.78	2,637.10	2,628.59	2,628.36
Δ -2LL		509.68	8.51	0.23
Δ df		13	3	1
significance		**	^	
Correctly classified cases	54.1%	67.8%	70.5%	70.6%
Nagelkerke R^2		0.24	0.25	0.24

** $p < 0.001$; * $p < 0.01$; ^ $p < 0.05$.

The empty model VI gives baseline values for the transformed loglikelihood (3,146.78) and the hit rate (54.1%). This latter figure is equal to the share of firms with no intentions to invest in process innovation in the forthcoming year. Model VII adds the control variables which again significantly improves model fit (Δ-2LL = 509.68 with Δdf = 13, $p < 0.001$). This step increases the percentage of correctly classified cases with 13.7%. Nagelkerke's R^2 equals 0.24 indicating a good strength between the independents and the probability of firms' intentions for process innovation. The significance and sizes of individual effect parameters again demonstrate that firm size and innovation strategy are strongly associated with this probability (b = 0.52 and b = 1.18, both with $p < 0.001$).

Model VIII adds the three competition measures. Goodness-of-fit improves (Δ-2LL = 8.51 with Δdf = 3, $p < 0.05$) and the same applies to the hit rate and Nagelkerke's R^2. Wald tests on the individual parameters show that only the bargaining power of suppliers contributes significantly to intended process innovation (b = 0.11, $p < 0.05$). Hypothesis 2 is confirmed. Besides, as we expected, the coefficients of internal rivalry and buyer power are insignificant[8].

Model IX enters the interaction term between innovation strategy and supplier power. The transformed loglikelihood value is now almost identical and far from significant. We find no moderating effect of innovation strategy on the connection between supplier power and intended process innovation, so hypothesis 5 is rejected.

5. Discussion

Using a new set of firm-specific measures this paper explored how various types of competition are connected with various types of innovation. Rather than using structural competition indicators such as concentration indices or measures of turbulence, we here based our exploration on perception-based measures of the competitive forces that firms encounter in their value chain: internal rivalry with other incumbent firms, bargaining

[8] Entering internal rivalry, supplier power and buyer power to the equation separately gives nearly identical results.

power of suppliers, and bargaining power of buyers. We used multiple-item, Likert-type measures with sufficient reliability, and well capable to retrieve plausible differences in perceived competition between industries and size classes.

Compared to previous work the results suggest a more subtle view of how competition and innovation are related. Drawing on survey data from 2,281 Dutch SMEs, buyer power appeared to be directly related to intended product innovation. When confronted with powerful customers, firms apparently prefer to avoid cutting prices by differentiating their products. Within certain boundaries they will also be willing to meet their customers' demands ('the customer is always right').

For supplier power we found a direct association with firms' intentions to invest in process innovation. This competitive force means that suppliers can enforce restrictions on the incumbent firm (such as price increases or quality reductions) without being punished. Firms probably need to adapt to such behaviour by attempting to achieve alternative cost savings or adjustments in their production processes to become less dependent on the supplier in the long run.

For internal rivalry we found a positive connection with intended product innovation, but only when firms do not maintain an innovation strategy. Similar to buyer power, this finding suggests that when firms perceive other incumbents as threatening, they prefer to avoid price cuts by developing new, differentiated products. However, if firms maintain an innovation strategy, the impact of internal rivalry becomes insignificant. Such firms will innovate anyway, and rivalry from other incumbents does not alter this. Innovative intentions as a consequence of internal rivalry were probably already taken into account when the strategy was defined.

Limitations

Our findings should be interpreted with a few caveats. In the introduction section we discussed the Schumpeterian hypotheses, implying that competition and innovation can, in general, be either positively or negatively related. Here we find some evidence for a positive connection, but remark that this may very well be an artifact of our survey data which included SMEs only. In general such firms operate in monopolistically competitive markets with many other (entrepreneurial) firms, so a positive connection between competition and innovation is likely. This result, however, cannot be generalized to the broader business population. In oligopolistic or monopolistic markets – when only a few large firms are active - the connection might in fact be negative.

Another comment is that in terms of size, the logistic regression parameters of our competition measures are rather modest. As an example, we found that buyer power is connected with intended product innovation with b = 0.15 (table 5). This implies that perceived bargaining power of buyers increases the odds of intended product innovation by exp(0.15) = 1.16 (Verbeek, 2004)[9]. We note that previous work identified many possible responses to perceived competition, including price reductions, accommodation (e.g. silent cooperation or mergers), ignorance (for instance when resources to respond are lacking) or even withdrawal from current markets (Gatignon & Reibstein, 1997). Likewise, Chen, Smith and Grimm (1992) argue that responses may be 'strategic' versus 'tactical'. Strategic responses include significant investments in fixed assets and/or people and results in major changes to structure and products. In

[9] In comparison, maintaining an innovation strategy increases the odds of intended product innovation by exp(1.57) = 4.81 (see table 5, model III).

contrast, tactical responses do not involve such commitments and require relatively minor, routine changes. Given that product and process innovation are only two of out many responses and that many competitive moves will be routine changes rather than innovations, modest effect sizes may, in fact, be plausible. Even so, future research should explore this phenomenon in more detail, for instance by capturing other competitive forces, other objects of innovation and new interaction variables that may enhance the connection between competition and innovation.

A final remark is that the survey data used for the analysis in this paper are cross-sectional. Despite the fact that our dependent variables were formulated in terms of innovative intentions, this paper is unable to deal with the two-way causality problem that challenges most empirical studies. To be truly convincing on the subject of causality, time series data and an improved research design, with a convincing source of exogenous variation in competitive forces, would be required. It is precisely for this reason that we formulated our hypotheses in terms of associations rather than causal relationships.

Implications and suggestions

Notwithstanding these caveats, the evidence presented in this paper has important implications. The 'humanized' approach with perception-based measures has already been applied in other contexts of industrial organization research, but is relatively new in the context of competition (Kemp et al. 2004). Perception-based measures account for the fact that individual firms can assess competitive forces differently, and respond in various ways and with varied intensity, even when they are active in the same market. This paper has shown that such measures enable more fine-grained analyses on how competition and innovation are related. Various types of competition are connected with various innovative intentions. In addition, our results show that the connection between competition and innovation is not monotonously positive or negative, but contingent on other variables. Here we demonstrated that innovation strategy moderates the strength of association between internal rivalry and intended product innovation, but of course many other contingency variables can be proposed.

Implications for future research are straightforward: one should continue in this direction by reproducing our findings in other contexts/countries, by investigating other competitive forces and other objects of innovation, and by proposing and testing new interaction variables. We repeat that we lacked data on the threat of substitute products and new entrants; two more competitive forces as described by Porter (1979). We can also easily think of other innovation objects that firms may use in their competitive moves, including new markets, raw materials and organizational innovations (Tidd et al. 2001). The investigation of such forces and moves would improve our understanding of the impact of competition on innovation.

The findings also have implications for policy makers attempting to promote innovation by means of competition measures. For instance, the evidence suggests that it is important to recognize that a change in a regulatory policy may affect various types of competition which, in turn, may result in various kinds of innovation activities. Therefore, any regulatory policy change intended to promote innovation should be evaluated against different types of competition. Stimulating competition could probably be more effective if specific types of competition were taken into account or aimed for. Of course, this first demands much more elaborated work to identify relevant

competitive forces, their connection with the types of innovation and contingency factors that moderate these relationships.

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